Remarks

Reconsideration of this Application is respectfully requested.

Upon entry of the foregoing amendment, claims 1-47 are pending in the application, with claims 1, 20 and 29 being the independent claims. Claim 26 has been amended to correct a minor error therein. This change is believed to add no new matter and its entry is respectfully requested.

Based on the foregoing amendment and the following remarks, Applicant respectfully requests that the Examiner reconsider all outstanding objections and rejections and that they be withdrawn.

Claim Objections

The Examiner has objected to claim 26 because, in lines 6-7, "each of the ZERO-INPUT response error vectors" should be changed to --each of the ZERO-STATE response error vectors-- to provide proper antecedent basis. Applicant has amended claim 26 as suggested by the Examiner. Accordingly, Applicant respectfully requests that the objection to claim 26 be reconsidered and withdrawn.

Nonstatutory Double Patenting Rejection

The Examiner has rejected claims 1-47 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-24 of U.S. Patent No. 6,980,951 to Chen[1] in view of Watts *et al.*, "A Vector ADPCM Analysis-by-

[1] In the office action, the Examiner refers to U.S. Patent No. 6,890,951. This is a patent entitled "Treatment of addiction and addiction-related behavior" to Dewey *et al.* Applicant has assumed that the Examiner meant to refer to commonly-owned U.S. Patent No. 6,980,951 to Chen which shares the same specification and inventive entity as the present application, and has responded accordingly.

Synthesis Configuration for 16 kbit/s Speech Coding," 1988 ("Watts"). Without acquiescing to the merits of this rejection, Applicant provides herewith a terminal disclaimer with respect to U.S. Patent No. 6,980,951 to Chen to obviate this rejection. Accordingly, Applicant respectfully requests that the rejection of claims 1-47 on the ground of obviousness-type double patenting be reconsidered and withdrawn.

Rejections under 35 U.S.C. § 102

The Examiner has rejected claims 1, 3-6, 8, 9, 12, 15, 29, 31-34, 36, 37, 40 and 43 under 35 U.S.C. § 102(b) as being anticipated by Watts *et al.*, "A Vector ADPCM Analysis-by-Synthesis Configuration for 16 kbit/s Speech Coding," 1988 ("Watts"). For the reasons set forth below, Applicant respectfully traverses.

Independent claims 1 and 29 each generally relate to a novel way of performing vector quantization in a Noise Feedback Coding (NFC) system. In particular, independent claim 1 is directed to a method in an NFC system of efficiently searching N predetermined Vector Quantization (VQ) codevectors for a preferred one of the N VQ codevectors to be used in coding a speech or audio signal. The method of claim 1 includes the steps of:

> (a) predicting the speech signal to derive a residual signal;
>
> (b) deriving a ZERO-INPUT response error vector common to each of the N VQ codevectors, wherein the ZERO-INPUT response error vector is a component of a quantization error vector;
>
> (c) deriving N ZERO-STATE response error vectors each based on a corresponding one of the N VQ codevectors, wherein each of the N ZERO-STATE response error vectors is a component of a quantization error vector;

(d) selecting the preferred one of the N VQ codevectors as the VQ output vector corresponding to the residual signal based on the ZERO-INPUT response error vector and the N ZERO-STATE response error vectors.

Independent claim 29 is directed to an NFC system for fast searching N VQ codevectors stored in a VQ codebook for a preferred one of the N VQ codevectors to be used for coding a speech or audio signal. The NFC system of claim 29 includes:

predicting logic adapted to predict the speech signal to derive a residual signal;

a ZERO-INPUT filter structure adapted to derive a ZERO-INPUT response error vector common to each of the N VQ codevectors in the VQ codebook, wherein the ZERO-INPUT response error vector is a component of a quantization error vector;

a ZERO-STATE filter structure adapted to derive N ZERO-STATE response error vectors each based on a corresponding one of the N VQ codevectors in the VQ codebook, wherein each of the N ZERO-STATE response error vectors is a component of a quantization error vector; and

a selector adapted to select the preferred one of the N VQ codevectors as a VQ output vector corresponding to the residual signal based on the ZERO-INPUT response error vector and the N ZERO-STATE response error vectors.

Watts teaches a coding structure that performs a Vector Quantizer (VQ) codebook search to code an input speech signal. In Watts, vectors representing predicted speech (denoted $\hat{x}_n$) and reconstructed speech (denoted y_n) are decomposed into zero-input response and zero-state response components as illustrated by equations (6)-(9) at page 9.2.2 of Watts. This decomposition simplifies the complexity in calculating a reconstruction error associated with a given codevector in a VQ codebook. In Watts, "reconstruction error" is defined as the difference between input speech (denoted x_n) and reconstructed speech y_n.

Watts does not teach each and every feature of independent claim 1 or 29. For example, as will be described in more detail below, Watts does not teach or suggest (1) an NFC system; or (2) deriving a ZERO-INPUT response error vector and N ZERO-STATE response error vectors that are components of a quantization error vector, as recited by those claims.

Watts Does Not Teach or Suggest a Noise Feedback Coding (NFC) System

As noted above, claim 1 recites a method for performing vector quantization in an NFC system while claim 29 recites an NFC system adapted to perform vector quantization. In contrast, the system disclosed by Watts is not an NFC system as that term is used in the present application. This is because the speech coder in Watts does not generate a difference signal between a quantizer input and output, pass this value through a filter, and then add the filtered output to a prediction residual to form the quantizer input signal. As set forth in the specification of the present application:

> In noise feedback coding, the difference signal between the quantizer input and output is passed through a filter, whose output is then added to the prediction residual to form the quantizer input signal. By carefully choosing the filter in the noise feedback path (called the *noise feedback filter*), the spectrum of the overall coding noise can be shaped to make the coding noise less audible to human ears.

See Specification at paragraph [0007].

In contrast to the foregoing description of a NFC system, the configuration disclosed by Watts never determines a difference signal between a quantizer input and output, let alone passes such a difference signal through a filter whose output is then added to the prediction residual to form the quantizer input signal. As such Watts does not teach or suggest an NFC system as recited in claims 1 or 29.

Watts Does Not Teach or Suggest Deriving a ZERO-INPUT Response Error Vector and N ZERO-STATE Response Error Vectors That Are Components of a Quantization Error Vector

Although Watts does describe calculating a "zero input response" and "zero state response" of a filter to select a codevector for the purposes of performing vector quantization, it does not teach deriving "a ZERO-INPUT response error vector common to each of the N VQ codevectors, wherein the ZERO-INPUT response error vector is a component of a quantization error vector" or deriving "N ZERO-STATE response error vectors each based on a corresponding one of the N VQ codevectors, wherein each of the N ZERO-STATE response error vectors is a component of a quantization error vector" as recited in claims 1 and 29.

As explained in the specification of the present application, an embodiment of the present invention decomposes a quantization error vector into a zero-input response error vector and a zero-state response error vectors:

> A computationally more efficient codebook search method according to the present invention is based on the observation that the feedback structure in FIG. 13C, for example, can be regarded as a linear system with the VQ codevector out of scaled VQ codebook 5028a as its input signal, and ***the quantization error q(n) as its output signal. The output vector of such a linear system can be decomposed into two components: a ZERO-INPUT response vector qzi(n) and a ZERO-STATE response vector vqs(n)***. The ZERO-INPUT response vector qzi(n) is the output vector of the linear system when its input vector is set to zero. The ZERO-STATE response vector qzs(n) is the output vector of the linear system when its internal states (filter memories) are set to zero (but the input vector is not set to zero).

See Specification at paragraph [0227] (emphasis added). Watts does not anywhere teach or suggest decomposing a vector representing quantization error (or any type of error for that matter) to derive a zero-input response error vector and zero-state response error vectors as recited in claims 1 and 29. Rather, Watts teaches decomposing vectors

representing predicted speech $\hat{x}_n$ and reconstructed speech y_n into zero-input response and zero-state response components as illustrated by equations (6)-(9) at page 9.2.2 of Watts. This difference between Watts and the invention of claims 1 and 29 is due in part to the structure of Watt's speech coder, which is depicted in FIG. 1(b) of Watts.

Since Watts does not teach or suggest each and every feature of independent claims 1 and 29, Watts cannot anticipate those claims. Dependent claims 3-6, 8, 9, 12, 15, 31-34, 36, 37, 40 and 43 are also not anticipated by Watts for the same reasons as independent claims 1 and 29 from which they depend and further in view of their own respective features. Accordingly, the Examiner's rejection of claims 1, 3-6, 8, 9, 12, 15, 29, 31-34, 36, 37, 40 and 43 under 35 U.S.C. § 102(b) are traversed and Applicant respectfully requests that these rejections be reconsidered and withdrawn.

Rejections under 35 U.S.C. § 103

Claims 2, 18, 30 and 46

The Examiner has rejected claims 2, 18, 30 and 46 under 35 U.S.C. § 103(a) as being unpatentable over Watts in view of U.S. Patent No. 5,828,996 to Iijima *et al.* ("Iijima"). Iijima, which discloses a speech signal encoder that includes a first encoding unit that performs sinusoidal analytic encoding of a voiced portion of an input speech signal and a second encoding unit that performs code excited linear prediction (CELP) encoding of an unvoiced portion of the input speech signal, does not remedy the deficiencies of Watts with respect to the features of independent claims 1 and 29. For example, like Watts, Iijima does not teach or suggest an NFC system or deriving a ZERO-INPUT response error vector and N ZERO-STATE response error vectors that

are components of a quantization error vector, as recited by those claims. Since the combination of Watts and Iijima does not render obvious independent claims 1 and 29, that combination also cannot render obvious claims 2, 18, 30 and 46 which depend from independent claims 1 and 29. Accordingly, the Examiner's rejection of claims 2, 18, 30 and 46 under 35 U.S.C. § 103(a) is traversed and Applicant respectfully requests that the rejection be reconsidered and withdrawn.

Claims 7, 10, 13, 16, 17, 35, 38, 41, 44 and 45

The Examiner has rejected claims 7, 10, 13, 16, 17, 35, 38, 41, 44 and 45 under 35 U.S.C. § 103(a) as being unpatentable over Watts in view of U.S. Patent No. 4,963,034 to Cuperman *et al.* ("Cuperman"). However, Cuperman teaches what appears to be the same analysis-by-synthesis (A-S) coding configuration disclosed in Watts. Consequently, Cuperman does not teach or suggest an NFC system or deriving a ZERO-INPUT response error vector and N ZERO-STATE response error vectors that are components of a quantization error vector, as recited by those claims. Since the combination of Watts and Cuperman does not render obvious independent claims 1 and 29, that combination also cannot render obvious claims 7, 10, 13, 16, 17, 35, 38, 41, 44 and 45 which depend from independent claims 1 and 29. Accordingly, the Examiner's rejection of claims 7, 10, 13, 16, 17, 35, 38, 41, 44 and 45 under 35 U.S.C. § 103(a) is traversed and Applicant respectfully requests that the rejection be reconsidered and withdrawn.

Claims 11, 14, 39 and 42

The Examiner has rejected claims 11, 14, 39 and 42 under 35 U.S.C. § 103(a) as being unpatentable over Watts in view of U.S. Patent No. 4,969,192 to Chen *et al.*

("Chen"). Chen, which describes a real-time vector adaptive predictive coder, does not remedy the deficiencies of Watts with respect to the features of independent claims 1 and 29. For example, like Watts, Chen does not teach or suggest an NFC system or deriving a ZERO-INPUT response error vector and N ZERO-STATE response error vectors that are components of a quantization error vector, as recited by those claims. Since the combination of Watts and Chen does not render obvious independent claims 1 and 29, that combination also cannot render obvious claims 11, 14, 39 and 42 which depend from independent claims 1 and 29. Accordingly, the Examiner's rejection of claims 11, 14, 39 and 42 under 35 U.S.C. § 103(a) is traversed and Applicant respectfully requests that the rejection be reconsidered and withdrawn.

Claims 19 and 47

The Examiner has rejected claims 19 and 47 under 35 U.S.C. § 103(a) as being unpatentable over Watts in view of U.S. Patent No. 5,475,712 to Sasaki. Sasaki, which describes a low-delay CELP voice coding system, does not remedy the deficiencies of Watts with respect to the features of independent claims 1 and 29. For example, like Watts, Sasaki does not teach or suggest an NFC system or deriving a ZERO-INPUT response error vector and N ZERO-STATE response error vectors that are components of a quantization error vector, as recited by those claims. Since the combination of Watts and Sasaki does not render obvious independent claims 1 and 29, that combination also cannot render obvious claims 19 and 47 which depend from independent claims 1 and 29. Accordingly, the Examiner's rejection of claims 19 and 47 under 35 U.S.C. § 103(a) is traversed and Applicant respectfully requests that the rejection be reconsidered and withdrawn.

Claims 20-23, 25 and 26

The Examiner has rejected under 35 U.S.C. § 103(a) as being unpatentable over Iijima in view of U.S. Patent No. 6,249,758 to Mermelstein *et al.* For the reasons set forth below, Applicant respectfully traverses.

Independent claim 20 is directed to a novel method of deriving a final set of codevectors for use in vector quantization. In particular, claim 20 recites a method of deriving a final set of N codevectors useable for prediction residual quantization of a speech or audio signal in a Noise Feedback Coding (NFC) system. The method of claim 20 includes the steps of:

> (a) deriving a sequence of residual signals corresponding to a sequence of input speech training signals;
>
> (b) quantizing each of the residual signals into a preferred codevector selected from an initial set of N codevectors to minimize a quantization error associated with the preferred codevector, thereby producing a sequence of preferred codevectors corresponding to the sequence of residual signals;
>
> (c) deriving a total quantization error energy for one of the N codevectors based on the quantization error associated with each occurrence of the one of the N codevectors in the sequence of preferred codevectors; and
>
> (d) updating the one of the N codevectors to minimize the total quantization error energy.

Iijima discloses a speech signal encoder that includes a first encoding unit 110 that performs sinusoidal analytic encoding of a voiced portion of an input speech signal and a second encoding unit 120 that performs code excited linear prediction (CELP) encoding of an unvoiced portion of the input speech signal. *See* Iijma, col. 2, l. 64-col. 3, l. 13. The Examiner asserts that various steps recited in claim 20 are taught by Iijima. Each of these assertions will be addressed in detail below.

First, the Examiner asserts that the recited step (a) of "deriving a sequence of residual signals corresponding to a sequence of input speech training signals" is taught (i) at column 2, line 64 through column 3, line 14 of Iijima and (ii) at column 11, line 46 through column 12, line 4 of Iijima. However, the text at column 2, line 64 through column 3, line 14 of Iijima merely states that the first encoding unit 110 finds short-term prediction residuals of an input speech signal, not an input speech *training* signal. In other words, the input speech signal being processed by first encoding unit 110 is not used for training a codebook or any other aspect of the encoder and thus the cited text cannot teach this particular feature of claim 20.

The text at column 11, line 46 through column 12, line 4 of Iijima describes the manner in which line spectra pair (LSP) parameters derived by first encoding unit 110 are vector-quantized by an LSP quantizer 134 within that encoding unit. This text states that with respect to the codebook used for performing this vector quantization, "[c]odebook learning is performed by the general Lloyd algorithm based on the respective distortion measures." The cited text in no way suggests that residual signals are used for this codebook learning process and thus the cited text also cannot teach "deriving a sequence of residual signals corresponding to a sequence of input speech training signals" as recited by claim 20.

Moreover, Applicant respectfully submits that it is inappropriate to find the term "residuals" in a first text portion of Iijima and the term "learning" in a second *completely unrelated* text portion of Iijima and then argue that the combined text portions teach or suggest "deriving a sequence of residual signals corresponding to a sequence of input speech training signals" as recited by claim 20.

Second, the Examiner asserts that the recited step (b) of "quantizing each of the residual signals into a preferred codevector selected from an initial set of N codevectors to minimize a quantization error associated with the preferred codevector, thereby producing a sequence of preferred codevectors corresponding to the sequence of residual signals" is taught at column 23, line 59 through column 24, line 62 of Iijima. However, this cited text describes the operation of Iijima's second encoding unit 120 (*see* Iijima at col. 23, line 59-64), which does not calculate a quantization error. Instead, Iijima's second encoding unit calculates the difference between a perceptually weighted version of the input speech signal and a synthesized version of the speech signal. Consequently, the cited text does not teach or suggest minimizing a quantization error as claimed.

Third, the Examiner asserts that the recited step (c) of "deriving a total quantization error energy for one of the N codevectors based on the quantization error associated with each occurrence of the one of the N codevectors in the sequence of preferred codevectors" is also taught at column 23, line 59 through column 24, line 62 of Iijima. However, as noted above, the cited text describes the operation of Iijima's second encoding unit 120, which does not calculate a quantization error but instead calculates the difference between a perceptually weighted version of the input speech signal and a synthesized version of the speech signal. Consequently, the cited text does not teach or suggest "deriving a total quantization error energy" as claimed.

Mermelstein, which describes a CELP encoding device, does not teach or suggest any of steps (a), (b) or (c) as recited in independent claim 20 and therefore does not remedy the aforementioned shortcomings of Iijima with respect to that claim. Since the combination of Iijima and Mermelstein does not teach or suggest each and every feature

of independent claim 20, those references cannot render claim 20 obvious. Claims 21-23, 25 and 26 are likewise not rendered obvious by Iijima and Mermelstein for the same reasons as independent claim 20 from which they depend and further in view of their own respective features. Accordingly, the Examiner's rejection of claims 20-23, 25 and 26 under 35 U.S.C. § 103(a) is traversed and Applicant respectfully requests that the rejection be reconsidered and withdrawn.

Claim 24

The Examiner rejected claim 24 under 35 U.S.C. § 103(a) as being unpatentable over Iijima in view of Mermelstein and further in view of U.S. Patent No. 6,104,992 to Gao *et al.* ("Gao"). Gao, which describes a multi-rate speech codec, does not remedy the deficiencies of Iijima and Mermelstein with respect to the features of independent claim 20 as described above. Since the combination of Iijima, Mermelstein and Gao does not render obvious independent claim 20, that combination also cannot render obvious claim 24 which depends from independent claim 20. Accordingly, the Examiner's rejection of claim 24 under 35 U.S.C. § 103(a) is traversed and Applicant respectfully requests that the rejection be reconsidered and withdrawn.

Other Matters

The Examiner has objected to claims 27 and 28 as being dependent upon a rejected base claim. By virtue of the foregoing remarks, Applicant has traversed the rejection of the claims upon which claims 27 and 28 depend. Accordingly, Applicant respectfully requests that the objection to claims 27 and 28 be reconsidered and withdrawn.

Conclusion

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn. Applicant believes that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Prompt and favorable consideration of this Amendment and Reply is respectfully requested.

Respectfully submitted,

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